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Pacific Northwest Region



Region-6

Water Quality Monitoring

Guides For Pesticide Detection



WATER QUALITY MONITORING GUIDES
FOR
PESTICIDE DETECTION

Prepared by:

Dallas Hughes, Hydrologist, Region 6
Paul Rea, Hydrologist, Gifford Pinchot NF
Bill Hanson, Hydrologist, Siskiyou NF
Jere Christner, Hydrologist, Willamette NF

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WATER QUALITY MONITORING GUIDES FOR
PESTICIDES DETECTION

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WATER QUALITY MONITORING GUIDES FOR
PESTICIDES

INTRODUCTION

Water quality monitoring is one part of the total monitoring job to be accomplished in pesticide application projects.

The intent of this document is to present recommended procedures for planning and conducting water quality monitoring for pesticide residues. This has resulted from analysis of previous monitoring guidelines, and experience gained in recent years. Previous guides were weak in several areas which are addressed in this document: evaluation criteria, detection of peak concentrations, early warning, contingency plans, and documentation.

As we gain more experience and refine monitoring techniques, the guidelines will be revised. Involvement of journeyman level watershed specialists in design, sampling, evaluation, and training will be necessary to achieve a good water quality monitoring program.

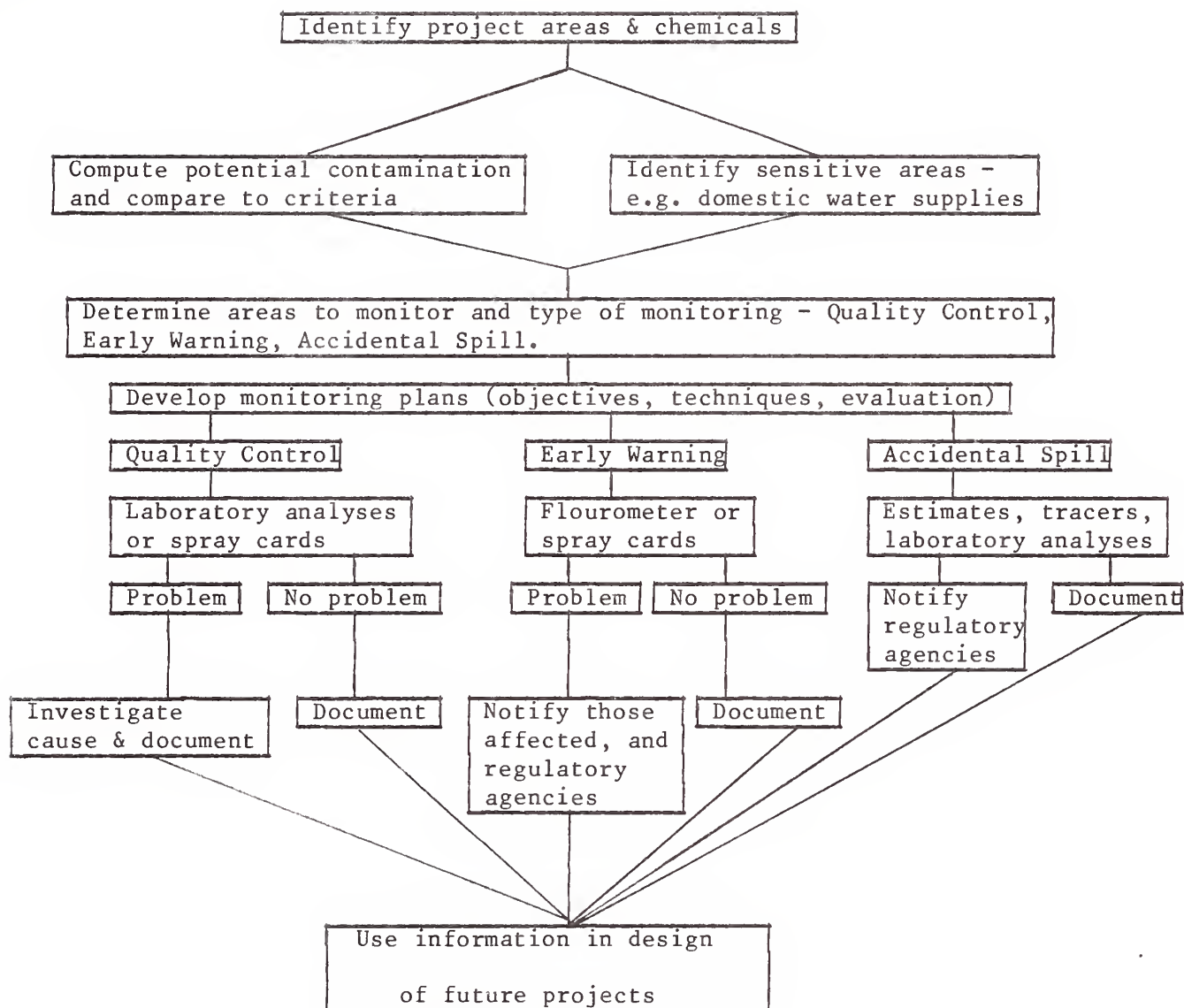
In addition to these guidelines, pesticide monitoring should be planned and conducted in accordance with direction given in FSM 2542 R-6 Supplement No. 39 (10/79).

An Environmental Protection Agency publication, "Silvicultural Chemicals and Protection of Water Quality" (EPA 91019-77-036, June 1977, prepared by Newton and Norgren) was used in developing these guidelines. This publication should be utilized by those involved in pesticide use and monitoring.

Enough water quality monitoring must be accomplished to assure the Forest Service, downstream users, the general public, and regulatory agencies that pesticide use activities are adequately protecting water quality.

Figure 1 illustrates the process which is described in the following guidelines.

Figure 1

Water Monitoring for Pesticide Detection

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PROJECT PLANNING

When pesticide application projects are being considered for water quality monitoring, the first requirements are to determine locations of live streams or other water bodies in or near the project boundaries and identify locations of beneficial water uses onsite and downstream which could be contaminated. As a minimum, inventory all domestic water supplies within a one-mile radius of any spray project for concern about aerial drift.

Computing Potential

Potential concentrations of introduced chemicals can be estimated using the method shown in Exhibit 1. These computations can then be used to determine monitoring priorities by relating quantitative potentials to criteria on harmful levels.

Evaluation Criteria

Exhibit 2 lists criteria for evaluating pesticide levels in water for many chemicals. Additional criteria are listed in Exhibits 3 and 4. See the section "Water Quality Criteria" for further discussion.

Water quality monitoring data should be evaluated to determine: (1) if criteria listed above were met; and (2) if concentrations of pesticides in water were kept as low as possible while still meeting land management objectives, e.g. spraying pesticide directly over streams is not acceptable even though criteria in (1) may be met.

Water Uses

The following should be considered as the highest priority areas to monitor:

1. Municipal supply watersheds
2. Other domestic supply watersheds
3. Fish hatchery watersheds
4. Important fish bearing streams and lakes
5. Important streams or lakes used for water contact recreation
6. Watersheds providing significant water volumes for irrigation or stock water, particularly where crops or products are sensitive to pesticides.
7. Socially sensitive areas

Persistence and mobility of pesticides should also be considered in selecting and planning water quality monitoring projects.

Analyses of the above computations, criteria, and values form the basis for formulation of the Forest's water quality monitoring program for pesticides. From these analyses each Forest will decide which projects to monitor and whether special "Early Warning" monitoring is needed for any of them. Information developed will also assist in formulation of contingency monitoring plans in case of accidental spills.

TYPES OF MONITORING

Three types of water quality monitoring for detection of pesticides are discussed below.

Quality Control Monitoring

The objective is to determine how well project quality control was maintained during pesticide application. On-the-ground observations and data collected as part of the the water monitoring effort are needed to evaluate the project and make any needed changes in future projects. For Quality Control monitoring, it is not necessary to obtain results of water samples immediately. The normal practice is to send samples to a laboratory for analyses. Results are generally known within two to three months after samples are submitted. This is the type of monitoring most commonly conducted in conjunction with Forest spray programs. It should always be accomplished as a quantitative check on Early Warning Monitoring. Spray cards can also be used for Quality Control Monitoring if it is only necessary to determine if any pesticide reached a stream by aerial drift.

For all pesticide application projects where Quality Control Monitoring is accomplished, at least one sample from each sampling point nearest downstream from a spray unit must be sent to a reputable laboratory for analyses (see Exhibit 5). This sample should be that most likely to approximate peak pesticide concentration (if any introduction to water occurred). It can be an individual sample or a composite of two to five samples.

If the first sample(s) show presence of pesticide, additional samples may be analyzed to better define the peak concentration pattern and to estimate the 24-hour mean (immediately after spray application). Additionally, samples should be analyzed from sampling points associated with this sampling point (e.g. upstream "control", downstream sampling point(s)).

If the second batch of samples indicates more chemical than is considered reasonable, all samples collected should be submitted for analysis to more fully describe the concentrations and changes over time.

Results are also compared with the calculated potentials (Exhibit 1) to determine if results seem possible or are likely due to human contamination of the water sample.

Early Warning Monitoring

In sensitive areas (e.g. municipal or fish hatchery watersheds, and near private domestic water supplies) there may be a need to have the capability of warning downstream users of a potential hazard. In most situations, the



potential for a hazard is remote unless an accidental spill occurs. Evaluation of hazards can be quantitatively predicted as shown in Exhibit 1. The decisionmaker must consider the emotional and political situation when deciding whether to provide an "Early Warning" type of monitoring. When this type of monitoring is undertaken, use of a tracer is suggested. Procedures for utilizing the tracers are identified in Exhibit 6. Fluorometers are normally used to accomplish Early Warning Monitoring, where quantitative estimates are made. Where these measurements are not necessary, rough quantitative estimates can be made from spray cards and/or an observer's report as to whether spray reached a stream, coupled with preliminary computations of the maximum possible pesticide concentrations (Exhibit 1).

For detecting dye tracers in water, use of a fluorometer in the field is usually needed to permit timely analyses. Since adsorption, leaching, and decay rates of dyes and pesticides may differ, this procedure can be used only to measure direct introduction to water immediately following the spraying. Results should be considered as estimates.

Water samples should be taken a short distance downstream of the spray project and the results used to estimate concentrations at points downstream on the basis of dilution. Quality Control Monitoring should be done concurrently with such efforts and should include a sampling point near the sensitive location; e.g., municipal supply intake.

Spray cards or plates may be especially valuable where the concern is aerial drift; e.g., cards could be established around a domestic supply spring. Spray cards are most applicable for determining whether or not spray was deposited at a site. If dye is calibrated in the pesticide spray mix, and a fluorometer is utilized, quantification estimates can be accomplished on a water sample if any dye is found on applicable spray cards. In any event, a prompt chemical analysis should be performed to verify the presence and quantify the pesticide concentration. This will normally take at least a few days, depending on the chemical.

When a Forest determines that Early Warning Monitoring is appropriate, concerned individuals may be notified (e.g. type of chemical, application rate, specific spray project location, and timing). The following is suggested for such situations:

1. Furnish the concerned individual(s) with our estimates of the worst potential contamination that could be expected (excepting a spill). These are from computations as in Exhibit 1.
2. Furnish the concerned individual(s) with evaluation criteria (Exhibits 2-4).
3. Advise the concerned individual(s) that we will notify them at least 24 hours in advance of when we will be spraying and immediately upon detection of any pesticide in the water.
4. Furnish the concerned individual(s) with phone numbers for additional assistance in interpreting the hazard if contamination is detected:

OREGON - Oregon Operations Office, Environmental Protection Agency
Phone No.: Commercial (503) 221-3250

Ask for Don Gipe (Alternate, Bill Titus). Outside of normal work hours, contact him or his representative through the Oregon Accident Response System, Phone 800-452-0311.

WASHINGTON - Washington State Department of Social & Health Service
Phone No.: Commercial (206) 753-5953

Ask for Ken Mary (Alternates, Terry Strong, John Kierner).
Outside of normal work hours, contact Ken Mary at (206) 352-8265.

Inform concerned individuals that the after-hour phone numbers should be contacted only when there is a serious concern after spraying that a hazard has been created.

5. The Forest Service should also notify these agencies after contacting the concerned individuals. If it is believed that no hazard exists, this call should be delayed until office hours. It should be understood that the above-mentioned phone numbers are for contamination other than by spills. Contamination resulting from accidental spills is generally much more hazardous and phone numbers in the section on Accidental Spill Monitoring are applicable.

Accidental Spill Monitoring

If a spill occurs in or near water, additional monitoring may be required and proper notification of the potential hazard made (FSM 2158.4). The National Response Center will be notified promptly when reportable spills occur (1-800-424-8802) through proper channels. Contingency plans for such an occurrence will be outlined in the project safety plan (FSM 2153.22).

Information should be collected to document spill location, time, type, and volume of chemical spilled. Estimates of streamflow should also be obtained, if feasible, at the spill site and downstream at the nearest point of major concern, e.g. domestic water supply intake. Travel time between these points should also be estimated, if feasible.

The monitoring effort is intended as a follow up to these estimates; i.e., to improve travel time estimates and document contaminant levels in the stream or other body of water.

1. Sampling - Noncontainment Case (Complete and direct entry to water)

a. Obtain sampling containers for laboratory analyses. If sampling containers are not available for the specific pesticide spilled, use clean glass bottles.

b. Immediately estimate when the spill first entered the water and the distance it may have traveled during the intervening time. If available, use a dye tracer to help estimate stream travel time.

c. Using the travel time measurement, estimate when the "slug" of spilled material will reach points of concern downstream and possibly one or more intermediate points upstream.

d. Obtain water samples at selected points to measure peak concentrations and to measure duration of contamination. It may be appropriate to sample at 15-minute intervals during the time of expected peak contamination and at hourly intervals thereafter until 24 hours have elapsed since the spill.

e. Submit individual or composite samples to an approved laboratory as soon as possible. Make laboratory arrangements with the objective of obtaining test results as soon as possible.

2. Sampling - Partial Containment Cases

Procedures are the same as for noncontainment cases with the following modifications:

a. Since partial containment may have both surface and subsurface flow reaching the stream, sampling will vary in intensity.

b. If the contaminant is exuded from the source area over a period of time, make travel time estimates for use in downstream sampling based on the expected duration of contamination. If contamination is still occurring from the spill source area when sampling is initiated, add a dye tracer to the source as long as contamination is occurring and sample at the selected point(s) downstream until dye is no longer visible. Continue sampling for at least 24 hours after the dye has disappeared.

3. Aquatic Organisms

If dead or distressed fish or other aquatic organisms are observed, collect specimens and report through emergency communications. Also consult the Forest Fisheries Biologist, Wildlife Biologist, and/or the State fisheries agency.

MONITORING PLANS

The pesticide project safety plan will provide for contingency water quality monitoring if an accidental spill occurs. Separate water quality monitoring plans are needed for pesticide application projects where "Quality Control" or "Early Warning" monitoring is planned. These plans should include the details necessary to accomplish the monitoring. Direction given in FSM 2542 R-6 Supp. No. 39 (10/79) is applicable. The monitoring plan should include the following items:

Monitoring Plan Components

1. Clear statement of objectives (Quality Control, Early Warning, or both). Objectives should include evaluation of specific protection measures employed; e.g., were streamside buffer strips wide enough?

2. Project area map showing location of monitoring stations in relation to pesticide treatment area; and narrative description of project area and monitoring stations.

3. Contamination potential based on computations (Exhibit 1).

4. Specific monitoring technique; i.e., equipment, determination of peak and 24-hour mean concentrations, sampling frequency and duration, and laboratory analyses. Include individual monitoring responsibilities.

5. Recordkeeping

a. Sample Station Record - A complete record of each individual sample station is required. (Figure 2)

b. Correspondence - The record should include all correspondence except financial transactions between the Forest, Ranger District, and laboratory doing the chemical analyses. It will include the current year's instructions from the analyzing facility, and the results of sample analysis with transmittal letters and chain of custody of sample bottles.

c. Project Chronology - Include the following information, some of which must be obtained by an observer of the application.

- (1) Pesticide, formulation, and manufacturer.
- (2) Application rate/acre.
- (3) Method of application and flight pattern.
- (4) Dates and times of application.
- (5) Weather conditions during application and water quality monitoring.
- (6) Remarks on any unusual occurrence that might affect water quality monitoring results.
- (7) Measures used to protect water quality.

6. Project evaluation and reporting - State how and when results will be evaluated. Reports are submitted to the appropriate line officer with recommendations as to whether protection was adequate; and if not, what specific improvements are needed.

PROCEDURES

1. Sampling Locations

In determining stations for collecting water samples for laboratory and/or fluorometer analyses, locations should be close enough to the spray project area that accurate measurements of streamflow travel time can be measured



Figure 2

SAMPLE STATION WATER MONITORING RECORD

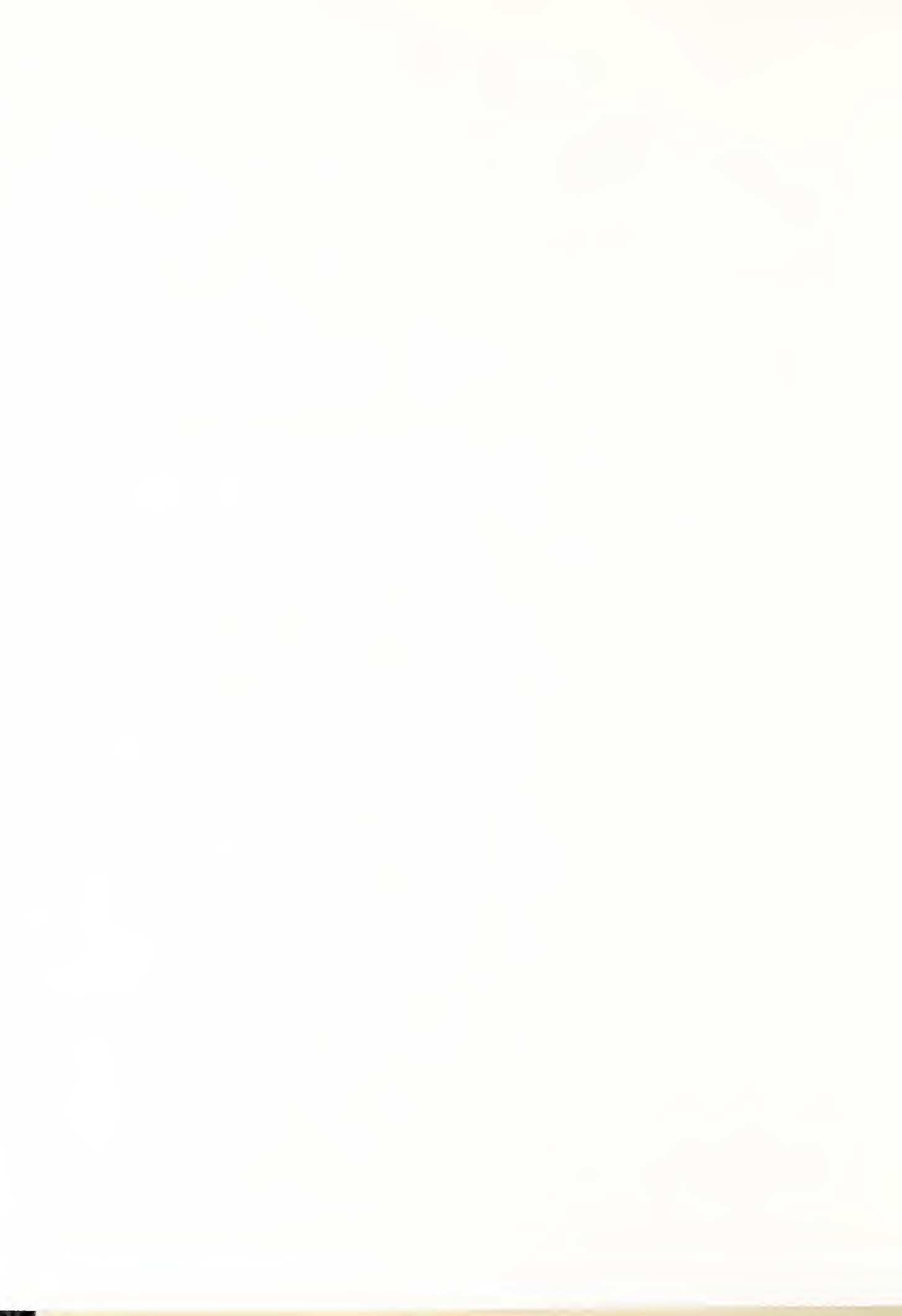
Ranger District _____ Sample Station No. _____

Legal Description _____

Location Description _____

Time of
Spray Application: Start _____ Finish _____ Type of
Pesticide Used _____

Sample Number	Date Sampled	Time Sampled	Name of Sampler	Remarks



with the technique selected, yet far enough away to insure good mixing of water leaving the spray unit and far enough away to avoid drift contamination to the water samples. One to two-hundred feet is the minimum distance recommended, depending on terrain and vegetative cover.

If more than one stream is potentially affected by a spray project and they cannot be measured at a single sampling point, it may be necessary to have two or more monitoring stations near the project. Additional monitoring sites may be needed at sensitive downstream locations. In some cases, it may be more feasible to simply estimate contamination at a downstream point by determining the dilution ratio.

2. Pework

A suggested means for measuring approximate peak pesticide concentrations is as follows: Determine streamflow travel times from the top and bottom of the spray unit to the downstream sampling points using tracers such as dye or salt. Ideally, the travel times should be measured as close as possible to the time of spraying. If flow changes noticeably before spray is applied, it may be necessary to take additional travel time measurements on the day of spraying. A staff gage is helpful to determine if significant flow changes occur.

On small streams, common salt is a good tracer when measured with a specific conductance meter. When conducting "Early Warning" monitoring, use a different tracer for determining travel times than used for detecting pesticide contamination (i.e., different dyes or salt and dye). Dye tracer used for travel times can linger and be measured when attempting to detect possible pesticide contamination if the same dye is used.

3. Sampling Frequency and Timing

Sampling frequency should be designed to detect the approximate peak contaminant concentration and 24-hour mean concentration immediately following pesticide application.

During the spray project, an observer must be in radio contact with the water sampler. The observer provides information concerning progression of the spraying operation to determine when water samples should be collected. Three to five samples are suggested to characterize the peak contaminant concentration. Timing of these samples can be determined, in part, by a duration curve from tracer measurements of travel time. It may be necessary to take these samples as close as 15 minutes apart. For "Early Warning" monitoring the focus is on a measurement of peak contaminant concentrations. Provisions must be made for rapid notification if unacceptable peak concentrations are detected.

Normally, about three samples should be taken after the peak concentration samples to estimate the maximum 24-hour mean concentration. Typically, these might be 4, 8, and 24 hours after the initial (peak) samples are collected. Additional samples should be taken if precipitation occurs within a week after spraying. "Control" samples should be taken at all sampling points before the pesticide spraying begins.

4. Sampling

Information below pertains to sample collection for chemical analysis in a laboratory. Information for "Early Warning" monitoring (fluorometer or spray card analyses) is found in references cited in Exhibit 6.

a. Order Containers

Inform the laboratory of the pesticide to be analyzed for, so that they can provide the proper type of containers and preservative (if any). Exhibit 5 is a list of laboratories approved by the Environmental Protection Agency.

b. Sample Collection

CAUTION: Personnel doing the water sampling and the sampling equipment and containers must be protected from any contact with the pesticide before, during, and after the spraying. Containers carried in a vehicle contaminated by pesticide or handled by an exposed person may be contaminated.

Care is required in handling containers with sodium hydroxide pellets. If the pellets are spilled, do not attempt to pick them up. If they are spilled within a building, sweep them up, then place them in a safe location and dissolve them in water. If spilled on the ground away from offices, homes, and other frequented areas, dissolve with water (pellets will dissolve slowly) and cover with soil. Avoid contact with one's skin, clothing, and particularly the eyes.

1. Check to insure that the proper containers will be used for the pesticide being sampled for.

2. Remove the cap and slowly sink the container in the main flow of the stream (preferably where there is a drop or falls in the channel). Samples should be depth-integrated. Attempt to sample as though hands are contaminated. The bottle opening should be facing upstream so that water does not contact the sampler's hands before entering the bottle. Do not sample in slow-moving pools or where there is a noticeable eddy effect. Boots worn in previous monitoring may be contaminated. Do not walk in the stream above the sampling point. Sample so that there is no possibility that material from boots or hands could enter the sample.

3. Report any observable film on the water surface and sample this separately.

4. After each sample is collected, care must be taken to fill out the sample identification tag and form correctly and completely. Each sample must be numbered, and the identification form given the identical number.

A suggested container numbering system is as follows: 2-digit Forest code, 2-digit District code, 2-digit station code, and 2-digit sample code, e.g. 11-02-01-02. Composite samples must also be identified with an identification tag when submitted for analysis.

Identification tags must also include the following information:

- (1) Station name (sampling location).
- (2) Date and time of sample(s) collection.
- (3) Name of person collecting the sample(s).
- (4) Weather at time of sampling.

A check of identification tags for completeness and correctness should be made prior to submitting samples for analysis. Analysis of samples will be coordinated through the Forest Supervisor's Office.

c. Storage of Samples for Future Use

Water samples shall be stored in a cool, dry location, completely removed from herbicide and/or other chemical storage. Water samples not treated with preservative can usually be held at about 4°C for a limited period of time. Some pesticides may require special care such as freezing. Samples that are not analyzed should be stored for a period no longer than 6 months after collection. Get instructions on storage from Standard Methods and the laboratory doing the analysis.

d. Samples Submission to a Laboratory

Samples may be submitted either individually or as composites of 2 to 5 samples. Analysis of composites is more economical, but detectable levels are not as low as with individual samples. Ask the laboratory about detectable levels for the pesticide to be sampled and match this with detection needs identified in the monitoring plan.

e. Chemical Analysis

Pesticide analysis of water samples should be accomplished by an EPA approved laboratory (see Exhibit 5). Care must be exercised throughout the sample collection, storage, and transportation processes to insure that samples do not become contaminated.

f. Tracers, Fluorometers, and Spray Cards

Information on use of dye tracers, fluorometers, and spray cards for pesticide water quality monitoring is contained in the references listed in Exhibit 6.

WATER QUALITY CRITERIA

There are no legal raw water quality standards at the present time for pesticides in Washington or Oregon.

Suggested evaluation criteria are given below for evaluating the significance of monitoring results:

1. Maximum 24-hour mean concentrations are listed in Exhibit 2. These criteria cover most of the pesticides. They were developed by Dr. Michael Newton for Environmental Protection Agency Region X under contract

with Oregon State University. The document is EPA 910/9-77-036, June 1977. The EPA position concerning endorsement of these criteria is shown in Exhibit 2. Note that these criteria consider streamflow and water use. The flow criteria relates to that at the time of the spray operation.

2. Safe Drinking Water Act standards. These criteria apply to only a few organic chemicals - endrin, lindane, methoxychlor, toxaphene, 2,4-D, and silvex. They apply only to "community water systems." These are public water systems which serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. The "maximum contaminant level" means the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system. It should also be recognized that the maximum contaminant level (MCL) values are not instantaneous peaks. If a sample exceeds the MCL, the supplier of water has 7 days to notify the State, and must collect three additional samples within a month. The average of these four samples is the MCL value. See Exhibit 3, Sections 141.12 and 141.24.

3. Oil - A sheen on the water surface is prohibited by the Federal Water Pollution Control Act. See Exhibit 4.

4. Background information for glyphosate (Roundup) is provided under an R-6 cover letter (2140) of 2/27/79 to Forest Supervisors and Resource Directors.

5. In addition to quantitative evaluation criteria, evaluation should also be made to determine if the application was conducted in a manner which kept water contamination as low as feasible while still meeting pesticide application objectives. This is achieved by documenting on-the-ground observations of conduct of the pesticide application including attention to weather conditions and forecasts.

Use of the procedure given in Exhibit 1 is recommended to compare with sampling results. This will indicate whether a high contamination level indicated by laboratory analysis is likely or whether the sample was possibly contaminated.

Exhibit 1

Computation of Potential Contamination:(Peak and 24-Hour Mean Concentrations, On-site and at Downstream Locations)

Assume the worst situation that might occur (except for a spill), i.e. direct application to the stream and first compute the potential contamination on-site. Do this by computing potential contamination if the stream were sprayed at the same rate as in the spray unit. Next, determine streamflow discharges on-site and at point(s) of concern downstream. Determine the dilution rate between the project area and downstream point(s) of concern. In addition to dilution, peak concentrations will diminish as water moves downstream due to dispersion (peaks flatten), chemical degradation, and adsorption of chemicals to sediments and organic matter. These additional factors could be considered in estimating potential downstream effects; however adequate modeling data is somewhat lacking and there will be considerable variation depending on such factors as the stream characteristics and the specific pesticide used. Environmental Protection Agency publication 910 discusses this. For the purpose of evaluating potential water monitoring projects, it will be necessary to simply recognize these as safety factors, but not include them in the computations. Following is an example to illustrate the use of making preliminary computations.

Situation

A herbicide spray project is planned. Two pounds per acre of 2, 4-D will be applied. A stream borders the project for a distance of 1000 feet. It averages 10 feet wide and 1 foot deep. The stream discharge is 1 cubic foot per second. Since $\text{Velocity} = \frac{\text{Discharge}}{\text{Width} \times \text{Depth}}$, the average velocity is 0.1 feet per second. A municipal supply intake is located five miles downstream where the stream discharge is 10 cubic feet per second. Assume that no buffer strip is left and coverage of the stream is the same as in the spray unit... in practice a buffer strip would be retained but the assumption is made to evaluate the maximum potential contamination. We want to determine the maximum potential peak concentration and the 24-hour mean concentration, both on-site and at the municipal supply intake.

On-site Potential Contamination:

$$\text{PC onsite} = \frac{368 \text{ P}}{\text{D}}$$

where PC is peak concentration in parts per billion (ppb)

P is pesticide application rate in pounds per acre

D is average stream depth in feet

368 is a constant. It is a ratio: $\frac{1 \text{ lb. of chemical/acre}}{1 \text{ lb. of water 1 ft. deep/acre}}$

$$\text{PC onsite} = \frac{368 \times 2}{1} = \underline{\underline{736}} \text{ ppb}$$

$$MC_{24} \text{ onsite} = \frac{PC(L)}{86,400 V}$$

where MC_{24} is the 24-hour mean concentration in parts per billion (ppb)
 PC is peak concentration in parts per billion - from the first equation.

L is stream length in feet

V is average stream velocity in feet per second

86,400 is a constant. It is the cubic feet of streamflow per day
 at a flow rate of 1 cubic foot/second.

$$MC_{24} \text{ onsite} = \frac{736 \times 1000}{86,400 \times 0.1} = \underline{\underline{85 \text{ ppb}}}$$

Downstream Potential Contamination:

$$PC \text{ downstream} = PC \text{ onsite} \times \frac{D_o}{D_d}$$

where D_o is stream discharge rate onsite and D_d is stream discharge rate downstream.

$$PC \text{ downstream} = 736 \text{ ppb} \times \frac{1 \text{ cfs}}{10 \text{ cfs}} = \underline{\underline{74 \text{ ppb}}}$$

$$MC_{24} \text{ downstream} = MC_{24} \text{ onsite} \times \frac{D_o}{D_d}$$

$$MC_{24} \text{ downstream} = 85 \text{ ppb} \times \frac{1 \text{ cfs}}{10 \text{ cfs}} = \underline{\underline{8 \text{ ppb}}}$$

For determining potential contamination from aerial drift, refer to Environmental Protection Agency publication 910 (Figure 7 and discussion).

Criteria given in Exhibits 2 and 3 are of value for evaluating the significance of the potential levels of 2,4-D calculated above. It must also be recognized that the objective should be to keep concentrations of pesticides in water as low as possible, while still meeting land management objectives, and that direct spraying of live streams must be avoided.

Table 3. Recommended concentration maxima for silvicultural chemicals by stream class and user group. Potable waters include safety factors for wildlife and aquatic organisms as well as humans.

Class	Chemical	Most Sensitive Test Species Affected	Test Basis & Concentration	Criteria, PPM 24 hr. Mean Stream Class & User					
				< 10 cfs Potable Irrig.	10 cfs Potable Irrig.	10 cfs-Navigable Irrig.	10 cfs Potable Irrig.	10 cfs Potable Irrig.	Navigable Irrig.
Fertilizer	Nitrate	Man	No effect, 10 mg/l N	10*	10*	10*	10*	10*	10*
Herbicide	Phosphate	Algae	Growth response var.	-----inadequate basis for recommendation-----					
	Amitrole	Daphnia	LC ₅₀ 48 hr, 3 mg/l	.15	0.1	.03	.01	.015	.01
	Ammonium ethyl carbamoyl phosphonate	Bluegill	LC ₅₀ 48 hr, 670 mg/l	5	5	1	1	0.5	0.5
	Arsenicals (organic)	Man	No effect, 0.12 mg/l	.1	.1*	.05*	.1*	.05*	.1*
Dalapon	Dicamba	Daphnia	LC ₅₀ 48 hr, 11.0 mg/l	.5	.1	.1	.02	.10	.02
		Bluegill	LC ₅₀ 96 hr, 23. mg/l	.2	.004	.05	.002	.01	.001
		-----inadequate data-----							
Picloram	Silvex ¹	Bass	LC ₅₀ 48 hr, 19.7 mg/l	.5	.001	.05	.0005	.005	.0001
		Chinook salmon	LC ₅₀ 48 hr, 1.2 mg/l	.06	.02	.03	.02	.01*	.01*
Triazines	2,4-D ¹	Daphnia	LC ₅₀ 48 hr, 1.0 mg/l	.05	.05	.03	.03	.01	.01
		Bluegill	LC ₅₀ 48 hr, 1.0 mg/l	.05	.05	.05	.02	.01	.005
		Bluegill	LC ₅₀ 48 hr, 1.4 mg/l	.06	.02	.03	.02	.01	.01

Table 3. (continued)

Class	Chemical	Most Sensitive Test Species Affected	Test Basis & Concentration	Criteria, PPM 24 hr. Mean			
				< 10 cfs Potable Irrig.	Stream Class & User 10 cfs-Navigable Irrig. Potable	Navigable Irrig.	
Herbicide	TCDD	Coho salmon	No effect 96 hr, .000000056 mg/l	-----	.000000006 for all water-----		
Insecticide	Carbaryl	Stonefly	LC ₅₀ 48 hr, .0048 mg/l	.001	.001	.0005	.0002
	Diazinon	Daphnia	LC ₅₀ 49 hr, .0009 mg/l	.0001	.0001	.00005	.00001
	Disulfoton	Stonefly	LC ₅₀ 48 hr, .005 mg/l	.001	.001	.00025	.00024
	Endosulfan	Rainbow trout	LC ₅₀ 96 hr, .0003 mg/l	.00003	.00003	.00001	.000003
	Endrin	Coho salmon	LC ₅₀ 96 hr, .0005 mg/l	.00005	.00005	.00001*	.000005
	Fenitrothion	Atlantic salmon	Behavior test 1 mg/l	.025	.025	.01	.005
	Guthion	Stonefly	LC ₅₀ 96 hr, .0015 mg/l	.0003	.0003	.0002	.00007
	Lindane	Brown trout	LC ₅₀ 48 hr, .002 mg/l	.0001	.0001	.00005	.00001*
	Malathion	Daphnia	LC ₅₀ 96 hr, .0018 mg/l	.0005	.0005	.0002*	.0001
	Phosphamidon	Daphnia	LC ₅₀ 48 hr, .0088 mg/l	.0005	.0005	.0005	.0002
	Trichlorfon	Stonefly	LC ₅₀ 96 hr, .016 mg/l	.002	.002	.0005	.00005

* As listed in QCW.

¹ The phenoxy herbicides may occur in water as esters or other forms. The given criteria for potable water may be increased by a factor of 10 for forms other than esters. Criteria for irrigation use are for total phenoxy herbicide.

REGION X

1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101



REPLY TO
ATTN OF: M/S 446

November 17, 1978

Arvid C. Ellson, Director
Watershed Management
P.O. Box 3623
Portland, OR 97208

Dear Mr. Ellson:

I am responding to your letter, dated November 8, 1978, in which you request a recommendation on whether to use the criteria listed in EPA publication 910/9-77-036 as targets for evaluating the results of USFS monitoring to determine if chemical application precautions are adequate. Specific reference is made to Table 1 and related statements in your enclosure entitled, "Impact of Forest Chemicals on Water Quality and Guidelines for Use", by Michael Newton, the consultant who authored EPA publication 910/9-77-036.

It is not correct to conclude that EPA has formally adopted or approved the published data in "910/9-77-036" as official national guidelines. The objective was to make available the best available knowledge on how to avoid undesirable water quality impacts resulting from forestry management uses of chemicals. We specified in the scope of work that this information "be compiled in a practical and scientifically sound format suitable for use by forest management analysts, silviculturists, contractors, aerial and ground applicators, scientific reviewers, extension agents, private land owners, state land boards, etc., in determining, formulating, or applying the most effective pollution control methods, procedures, and programs." The resultant product clearly shows that silvicultural chemicals, when proper precautions and safeguards are taken, can be used without major adverse environmental impacts. However, the guidance and suggested criteria are qualified, and it is still the responsibility of the user to determine how this and any other available information can be employed to keep an operation safe.

Sincerely,

William D. Clothier

William D. Clothier, Chief
Nonpoint Sources Section



Safe Drinking Water Act Criteria Federal Register Volume 40,
No. 248 (12/24/75) and Volume 41, No. 133 (7/9/76)

§ 141.12 Maximum contaminant levels for organic chemicals.

The following are the maximum contaminant levels for organic chemicals. They apply only to community water systems. Compliance with maximum contaminant levels for organic chemicals is calculated pursuant to § 141.24.

	Level, milligrams per liter
(a) Chlorinated hydrocarbons:	
Endrin (1,2,3,4,10, 10-hexachloro-6,7-epoxy-1,4, 4a,5,6,7,8,8a-octa-hydro-1,4-endo, endo-5,8 - di-methano naphthalene).	0.0002
Lindane (1,2,3,4,5,6-hexachloro-cyclohexane, gamma isomer).	0.004
Methoxychlor (1,1,1-Trichloro-2, 2 - bis [p-methoxyphenyl] ethane).	0.1
Toxaphene (C ₁₂ H ₈ Cl ₆ -Technical chlorinated camphene, 67-69 percent chlorine).	0.005
(b) Chlorophenoxys:	
2,4 - D, (2,4-Dichlorophenoxyacetic acid).	0.1
2,4,5-TP Silver (2,4,5-Trichlorophenoxypropionic acid).	0.01

§ 141.24 Organic chemical sampling and analytical requirements.

(a) An analysis of substances for the purpose of determining compliance with § 141.12 shall be made as follows:

(1) For all community water systems utilizing surface water sources, analyses shall be completed within one year following the effective date of this part. Samples analyzed shall be collected during the period of the year designated by the State as the period when contamination by pesticides is most likely to occur. These analyses shall be repeated at intervals specified by the State but in no event less frequently than at three year intervals.

(2) For community water systems utilizing only ground water sources,

analyses shall be completed by those systems specified by the State.

(b) If the result of an analysis made pursuant to paragraph (a) of this section indicates that the level of any contaminant listed in § 141.12 exceeds the maximum contaminant level, the supplier of water shall report to the State within 7 days and initiate three additional analyses within one month.

(c) When the average of four analyses made pursuant to paragraph (b) of this section, rounded to the same number of significant figures as the maximum contaminant level for the substance in question, exceeds the maximum contaminant level, the supplier of water shall report to the State pursuant to § 141.31 and give notice to the public pursuant to § 141.32. Monitoring after public notification shall be at a frequency designated by the State and shall continue until the maximum contaminant level has not been exceeded in two successive samples or until a monitoring schedule as a condition to a variance, exemption or enforcement action shall become effective.

(d) For the initial analysis required by paragraph (a) (1) and (2) of this section, data for surface water acquired within one year prior to the effective date of this part and data for ground water acquired within three years prior to the effective date of this part may be substituted at the discretion of the State.

(e) Analyses made to determine compliance with § 141.12(a) shall be made in accordance with "Method for Organochlorine Pesticides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

(f) Analyses made to determine compliance with § 141.12(b) shall be conducted in accordance with "Methods for Chlorinated Phenoxy Acid Herbicides in Industrial Effluents," MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.



Exhibit 4
DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

20

MAILING ADDRESS
COMMANDER (2061)
THIRTEENTH COAST GUARD DISTRICT
915 SECOND AVE
SEATTLE, WASH 98174
PHONE

206 442-7523

16476
DPL78-659

OCT 13 1978

Mr. Curtis L. Swanson
Regional Environmental Coordinator
United States Department of Agriculture
Forest Service
Region 6
P. O. Box 3623
Portland, OR 97208

Dear Mr. Swanson:


We have reviewed your 16 August 1978 letter of notification, addressing the ongoing herbicide program covered within your final environmental impact statement (USDA-FS-R6-FES (Adm.) 75018 (Revised)) of 6 March 1978.

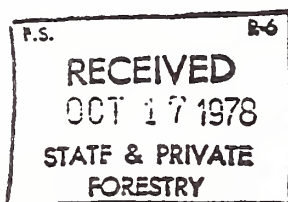
Most of the herbicides use an oil based carrier (table 6, page 51). Spraying in sufficient quantity to create a sheen on water is prohibited by the Federal Water Pollution Control Act. Letter #51 on page 200 points out this hazard. In any event, the forest areas under consideration also fall within the purview of EPA regulation.

The Coast Guard perceives no objection to the proposed extension as long as the project avoids the placing of a "harmful quantity" of oil in the waters within the project area. A "harmful quantity" is defined as any quantity which causes . . . "a film or sheen upon or discoloration of the surface of the water or adjoining shorelines . . . or causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines." (40 CFR 110.3 (d))

If more information is desired please contact CDR H. N. HUTCHINS, Chief, Marine Environmental Protection Branch, Telephone: (206) 442-5850.

Sincerely,


RICHARD F. MALM
Captain, U. S. Coast Guard
Chief of Staff
Thirteenth Coast Guard District



Copy to: COMDT COGARD (G-WEP)
EPA,
EPA, Region X

Exhibit 5

Region 6, U. S. Forest Service has an existing memoranda of agreement with the State of Oregon Department of Agriculture for pesticide analytical services. This State laboratory can test for any of the pesticides listed in the attachment. The price list usually changes once or twice each year.

Attached also is a list of other laboratories approved by the EPA for the specified pesticides.

Department of Agriculture

22

Date: January 18, 1979 MEMORANDUM

To: State, Federal Agencies Utilizing OSDA Laboratory Services for Contractual Pesticide Residue Analysis

From: Mike Wehr *MW*

Subject: REVISED ANALYTICAL AND SAMPLE CONTAINER FEE SCHEDULE, ORDERING INFORMATION

As provided for in existing memoranda of agreement, the following are revised charges for pesticides analytical services and one-gallon sampling containers provided by Laboratory Services, Oregon Department of Agriculture. These prices are effective immediately. Please note that we are anticipating another revision of fees after July 1, 1979.

Ordering information is outlined at the end of this memorandum.

A. Pesticide Residue Analysis

<u>Analysis Requested</u>	<u>Cost per Sample (\$)</u>
Routine analysis of water, soil, or foliage samples submitted for analysis of one or more of the following compounds: 2,4-D, 2,4,5-T, 2,4,5-TP, picloram, atrazine, simazine.	61.50
Analysis of water for Krenite, Round-up *Subject to change with increasing analytical experience	139.00*
Analysis of water, soil, or foliage samples for all other compounds	Analytical hours required at \$28.00/hour
Common agricultural commodities (fruits, vegetables, grains, etc.) and processed foods: screen for organo-phosphates, halocarbons. Extensive compound confirmation and analysis for unusual insecticides, or analysis for herbicides charged on an hourly basis at a rate of \$2.00 per hour.	56.00

B. Pesticide Formulations (Pesticides in original manufacturer's container.) See attached fee schedule. These represent usual hourly/cost figures and are subject to change by OSDA

Laboratory Services depending upon exact nature and state of the sample.

C. Tank mixes.

Charges based on actual analytical time at an hourly cost figure of \$26.50. We suggest contacting the laboratory prior to submission of samples of this type since adjuncts (emulsifiers, binders-stickers, etc.) may modify or prevent our ability to analyze samples of this type.

D. Sample containers. Available at a cost of \$2.25 each (includes container itself, any necessary added chemicals, preparation time, mailing charges, other miscellaneous costs). Please allow a minimum of two weeks following receipt of your order for delivery of ordered containers.

Ordering Information:

- A. Unless otherwise agreed upon, a purchase order must be received with each request for analysis or containers. The purchase order must specify the exact number of samples to be analyzed (including specific information on the pesticides for which analysis is needed) or containers required.
- B. For container orders, please specify with or without preservatives. Krenite and Round-Up samples must be in containers without preservative.
- C. Mail or deliver all samples and purchase orders to Oregon Department of Agriculture, Laboratory Services, Room 214, Agriculture Bldg., 635 Capitol St. NE, Salem, OR 97310. Purchase orders should be made out to the same laboratory and address.
- D. Please utilize Oregon Department of Agriculture form No. 2003, Request for Analysis - Pesticide Residue, for all samples. These forms can be obtained from the laboratory at no charge by directing a request to the address in (C) above or by calling (503) 378-3793, FTS 530-3793.

Pesticide Formulation:

<u>Test</u>	<u>Analysis Time per Sample (hr.)</u>	<u>Cost per Sample (\$)</u>
Acid, total	2.0	53.00
Aldrin	4.5	119.50
Alkaloid	6.0	159.00
Amitrol	3.0	79.50
Arsenic (Metallic)	4.5	119.50
Balan	4.5	119.50
Baygon	4.5	119.50
Baytex	4.5	119.50
Benomyl (Benlate)	4.0	106.00



<u>Test</u>	<u>Analysis Time per Sample (hr.)</u>	<u>Cost per Sample (\$)</u>
Betasan	3.0	79.50
Botran	4.5	119.50
Bromoxynil	4.5	119.50
Bromocil	4.5	119.50
Cacodylic acid	4.5	119.50
Calcium Arsenate	2.0	53.00
Calcium hypochlorite	2.0	53.00
Calcium polysulfide	4.0	106.00
Calcium Thiosulfate	5.0	132.50
Captan	4.5	119.50
Carbaryl	3.0	79.50
Chlordane & chlordane technical	4.5	119.50
Chloride (total)	4.5	119.50
Chlorophacinone (Rozol)	4.5	119.50
Chloro-IPC	4.5	119.50
Ciodrin	4.5	119.50
Copper (metallic)	1.0	26.50
Copper (organic)	3.0	79.50
Cube extraction	2.0	53.00
Cygon	4.5	119.50
Cyanimid cytrol	3.0	79.50
Cyprex	4.5	119.50
2,4-D (acid equivalent)	1.5	40.00
2,4-D (acid equivalent, esters)	4.0	106.00
2,4-Dichloro-p-nitrophenyl ether (TOK)	4.0	106.00
Dacthal	4.25	112.50
DDT-DDD	2.5	66.50
Demethon	4.4	116.50
Diazinon	4.5	119.50
Dicamba	2.0	53.00
Dichlone	4.5	119.50
Dichlorobenil	1.25	33.50
1,3 Dichloropropene	4.0	106.00
Dieldrin	4.5	119.50
Difolatan	4.0	106.00
Dimethoate	4.5	119.50
Dimethylamine salt	6.0	159.00
Disyston	2.5	66.50
Dinitro-o-sec-butylphenol	5.0	132.50
Diphenamid	4.0	106.00
Dithane	4.5	119.50
Dithiocarbamates	4.5	119.50
Diuron (in fertilizer mixes)	4.75	126.00
Diquat	4.0	106.00
Duter	4.5	119.50
Dylox	4.5	119.50
Dyfonate	4.5	119.50
Eptam	4.5	119.50
Ethion	4.0	106.00

<u>Test</u>	<u>Analysis Time per Sample (hr.)</u>	<u>Cost per Sample (\$)</u>
Ethylene dibromide	4.5	119.50
Ethylene dichloride	4.5	119.50
Fluorine	3.0	79.50
Fluorosilicate (sodium)	2.0	53.00
Folpet	4.5	119.50
Formaldehyde	4.5	119.50
Fumarin	4.5	119.50
Fundal	4.0	106.00
Gamma isomer of BHC	4.5	119.50
Gardona	4.5	119.50
Guthion	4.0	106.00
Imidan	4.5	119.50
Indolbutyric acid	4.5	119.50
IPC	2.0	53.00
Iso-octyl ester of 2,4-D/2,4,5-T as pesticide residue in water (batch of 6)	1.5 (each)	40.00
Karathane	1.5	40.00
Kelthane	4.5	119.50
Lead	2.0	53.00
Lindane	4.5	119.50
Linuron	4.5	119.50
Malathion	2.5	66.50
Maneb	2.5	66.50
Manganese	4.5	119.50
Manzate-D	4.5	119.50
Mesuroi	4.5	119.50
MCPA	4.0	106.00
MCPB	4.0	106.00
MCPP	4.0	106.00
Metallic mercury	2.0	53.00
Metallic zinc	2.0	53.00
Methoxychlor	4.5	119.50
Methyl isothiocyanate	4.5	119.50
MGK (all numbers)	4.0	106.00
Monosodium acid methyl arsenate	4.5	119.50
Napthalene	4.0	106.00
Napthalene acetic acid	4.5	119.50
Nicotine	2.0	53.00
Norbormide	4.0	106.00
Para-dichlorobenzene	4.0	106.00
Paraquat	4.5	119.50
Parathion	4.5	119.50
Patoran	4.5	119.50
Pentachloronitrobenzene (terrachlor)	4.5	119.50
Pentachlorophenol	4.0	106.00
Perthane	4.0	106.00
Petroleum oils	1.0	25.50
Phenyl mercury acetate (PMA)	2.0	53.00

<u>Test</u>	<u>Analysis Time per Sample (hr.)</u>	<u>Cost per Sample (\$)</u>
Phosalone	4.5	119.50
Phosdrin	4.5	119.50
Phosphomedon	5.0	132.50
Piperonyl butoxide	3.0	79.50
Polyram	2.0	53.00
Promethone	4.5	119.50
Pyrazone	5.0	132.50
Pyrethrin	6.0	159.00
Quaternary (simple)	2.0	53.00
Resmethrin	4.0	106.00
Roneet	4.5	119.50
Rotenone	3.0	79.50
Sevin	4.5	119.50
Silvex	3.0	79.50
Simazine	4.5	119.50
Sinbar (terbacil)	4.5	119.50
Sodium fluorsilicate	2.0	53.00
Sodium fluoroacetate "1080" (qualitative)	1.5	40.00
Strychnine alkaloid	3.0	79.50
Sulfoxide	6.0	159.00
Sulfer	2.0	53.00
Sulfaquinoxaline	3.0	79.50
Sutan	4.5	119.50
Systox	4.5	119.50
Tandex	4.5	119.50
Technical chlordane	4.5	119.50
Tenoran	4.0	106.00
Terbacil	4.5	119.50
Tetraethylpyrophosphate (TEPP)	5.0	132.50
Tetrachloroisophthalonitrate	4.0	106.00
Thimet	4.0	106.00
Thiodane	2.5	66.50
Thiram	4.5	119.50
Toxaphene	4.0	106.00
Tordon	4.5	119.50
Triethylamine salt of 2,4-D/2,4,5-T	7.0	185.50
Trifluoralin	4.5	119.50
Trithion	3.0	79.50
Unulfonated oils	2.0	53.00
Vacor	4.5	119.50
Vapam	4.5	119.50
Vapona (pet collars)	5.0	132.50
Ziram	2.0	53.00
Zinc phosphide	3.0	79.50
Zineb	4.5	119.50
Warfarin	3.0	79.50
Water (toluene distillation)	1.0	26.50

Tank mixes: All samples charged on basis of actual analytical time and an hourly cost figure of \$26.50.

Note: Individual laboratories are approved only for the contaminant analyses indicated by "X"

May 8, 1978

Page 1 of 2

	Endrin	Lindane	Methoxychlor	Toxaphene	2,4-D	2,4,5-TP
<p>CH2M/Hill (Redding Lab) P. O. Box 428 1600 S. W. Western Blvd. Corvallis, OR 97330 (503) 752-4271</p>	X	X	X	X	X	X
<p>Chinook Research Laboratories P. O. Box 1392 Corvallis, OR 97330 (503) 757-7990</p>	X	X	X	X	X	X
<p>Columbia Laboratories P. O. Box 40 Corbett, OR 97019 (503) 375-2287</p>	X	X	X	X	X	X
<p>Impqua Research Co. P. O. Box 791 626 N. E. Division St. Hartle Creek, OR 97457 (503) 863-5201</p>	X	X	X	X	X	X

Note: Individual laboratories are approved only for the contaminant analyses indicated by "X"

May 8, 1978 Page 2 of 2

	Endrin	Lindane	Methoxychlor	Toxaphene	2,4-D	2,4,5-TP
Water Consulting & Analysis 304 Blair Blvd. Eugene, OR 97402 (503) 485-8404					X	X
Oregon State Department of Agriculture Laboratory* Agriculture Building Salem, OR 97310 (503) 378-3793	X	X	X	X	X	X

*The Department of Agriculture Laboratory has received approval by EPA but will not perform the routine organic chemical analyses required by the EPA regulations. Commercial laboratories should be contacted for these analyses.

Exhibit 6

Reference List

Dye Tracers

1. The Water Tracer's Cookbook. Tom Aley, Mark Twain N.F., 1971 (unpublished). 1/
2. Water Quality Monitoring on Herbicide Spray Projects. Bill Johnson, San Bernadino N.F. (unpublished). 1/
3. Dye Tracer Techniques, Region 5 U.S.F.S. (unpublished). 2/
4. Water Quality Following Aerial Herbicide Spraying. Jere Christner, Willamette N.F., 1979 (unpublished). 3/
5. Use of Dye Tracer to Aid Water Quality Monitoring of a Herbicide Spray Project, 1978. Jere Christner. 5/

Accidental Spills

1. Oil and Hazardous Substances Response Manual. EPA (issued 1979 but no number or date on publication). 4/
2. Oregon Accident Response System (unpublished) 1979. 4/

1/ R-6 2540 (2470) 1/28/74

2/ R-6 2540 (2140), exhibit 6, 3/15/78

3/ R-6 2540 4/2/79

4/ R-6 1590 (Oregon Forests) 12/28/79

5/ R-6 2540's 12/12/78 and 2/20/79



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